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ABSTRACT

This study investigated the development of abstract mathematical thought and spatial relations of 13- and 14-year-old students who attended public schools in Australia, Japan, and the United States. Dependent variables included age, ability grouping, ethnicity, sex, mathematics attitudes, and mathematics classroom behaviors. Significant differences were found for age in all cases except Japanese spatial relations. Accelerated mathematics ability group membership had the largest significant predictive regression weight for the United States and Australia. Lowest mathematics ability group membership had a significant, negative regression weight for U.S. students and a non-significant regression weight for the Australian sample. Sex differences favored Australian females. Intrinsic motivation to study mathematics was the most universal significant regression weight. Mathematics confidence and lack of anxiety were significant predictors for Australian and U.S. Caucasian males and Japanese males, but not for females in any regression. Mathematics usefulness was a significant predictor for Japanese and Australian Asian students. Mathematics as a gender neutral subject was a significant negative predictor for Australian Caucasian males and a positive predictor for all other groups. Tables of correlations, means, and standard deviations in each group are appended. Lists 40 references. (Author/YP)

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Cross-cultural Investigations into Student Development of Spatial Relations and Abstract Mathematical Thought: Some Preliminary Findings from Australia, Japan and the United States

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Abstract

This study investigates the development of (a) abstract mathematical thought (AMT) and (b) spatial relations of 13 and 14 year old students attending public schools in Australia (n=979), Japan (n=216) and the United States (n=549). Dependent variables include (a) age, (b) ability grouping, (c) ethnicity, (d) sex, (e) mathematics attitudes, and (f) mathematics classroom behaviors. Significant differences are found for age in all cases except Japanese spatial relations. Accelerated mathematics ability group membership has the largest significant predictive regression weight for the U.S. and Australia. Lowest mathematics ability group membership has a significant, negative regression weight U.S. students and a non-significant regression weight for the Australia sample. Sex differences found favor Australian females (at $p<.01$). Intrinsic motivation to study mathematics is the most universal significant regression weight. Mathematics confidence and lack of anxiety are significant predictors for Australian and U.S. caucasian males and Japanese males, but not for females in any regression. Mathematics usefulness is a significant predictor for Japanese and Australian Asian students. Mathematics as a gender neutral subject is a significant negative predictor for Australian caucasian males and a positive predictor for all other groups.

Investigations in the United States suggest a close association exists

between student development of (a) abstract mathematical thought (AMT) and (b) spatial relations and student advanced mathematics physical science achievement (Flanagan et al., 1964). Abstract mathematical thought, as used in this investigation, is the ability to mentally manipulate and translate abstract symbols into concrete or into other abstract phenomena. Spatial relations, as used in this investigation, is the ability to observe a phenomenon in two dimensions and mentally translate and rotate the observation in three or more dimensions.

In international studies of mathematics achievement, United States eighth and twelfth grade student mathematics mean achievement scores are at or below the median of the means of nineteen other developed and developing countries Husen, 1967; IEA-SIMS, 1985; McKnight et al., 1987). The Japanese student mathematics mean scores are consistently in first or second place. The objective of this study is to increase understanding of variables which significantly contribute to student development of abstract mathematical thought and spatial relations. The cross-cultural nature of the study offers a richer insight into student mathematics achievement.

The Australian sample contains 979 students, principally in seventh and eighth grade. The students attend four public schools in a medium sized city. Each school is independently administered. Two group by ability in mathematics and two do not. The mathematics curriculum is defined by the individual school. The two schools which group by ability in mathematics also differentiate in one other curriculum: one in language and one in vocational arts.

The Japan sample contains 216 seventh and eighth grade students in a medium sized suburban public school. Japanese public school students are not

grouped by ability until after grade 9, the end of compulsory education. The Japanese students participate in all other school curricula without differentiation. The mathematics curriculum is defined by the Japan Ministry of Education.

The U.S. sample contains 549 seventh and eighth grade students in a medium sized mid-west public school district. The U.S. school district groups students by ability in only one curriculum, mathematics. The U.S. students participate in all other school curricula without differentiation. The mathematics curriculum is defined by the district for each ability group.

The Australian, Japanese and U.S. students are examined for nineteen independent variables which prior research studies indicate have an association with student achievement in mathematics and the physical sciences. The variables include (a) grade in school (age), (b) ability group membership, (c) ethnicity, (d) sex, (e) student mathematics attitudes, and (f) teacher observed student mathematics classroom behaviors. In addition to collection of statistical data, the schools and mathematics classrooms were visited on a number of occasions to obtain a sense of the school and classroom climates, operations, and curriculum; teaching objectives, methods and practices; and student interaction with teachers and administrators, peers, families, and the mathematics learning processes.

Four measurement instruments were used to obtain data:

1. The Space Relations section of the Differential Aptitude Test (Bennett, Seashore & Wesman, 1982) to measure spatial relations, as previously described.

2. The Iowa Algebra Aptitude Test (Greene & Sabers, 1967) to measure abstract mathematical thought.

3. The Fennema-Sherman Mathematics Attitude Scales (Fennema & Sherman, 1976) to measure nine mathematics related attitudes.

4. A teacher questionnaire to measure six student mathematics classroom behaviors.

Some of the analyses performed on the samples and various sub-groups are: (a) standardized, backward elimination, forward addition and stepwise regressions; (b) t-tests; and (c) Duncan Multiple Range tests. Means, standard deviations and correlations by-country-sex-gender are located in the Appendix.

Preliminary Results

For schools that group by ability, accelerated mathematics ability group membership has the largest significant predictive regression weight in the U.S. and Australia regressions on AMT (Table 1). Membership in the highest mathematics ability group has a large, positive regression weight (raw weights: Australia, 15.73 at $p<.0001$; U.S. 14.81 at $p<.0001$) and membership in the lowest ability group has a negative regression weight (raw weight: U.S., -8.18 at $p<.0001$). The finding of a non-significant regression weight for the Australia sample for membership in the lowest mathematics ability group suggests the developmental effects on AMT of being a member of this group may not be as great for the Australian sample as compared with the U.S. sample.

[-----PLACE TABLE 1 ABOUT HERE-----]

Cross-cultural comparison of the seventh and eighth grade AMT means indicate the U.S. sample mean for each grade is the highest followed by Japan and Australia and the differences between countries is significant at $p<.01$ (Table 2). The percent difference in seventh and eighth grade means is greatest for Australia, 20%; followed by Japan, 15%; and United States, 12%.

[.....PLACE TABLE 2 ABOUT HERE-----]

The Iowa Algebra Aptitude Test contains problem types not normally studied in seventh and eighth grade. It is not a computational test, but a test of associating abstract operations in an example with abstract operations on following question problems. One possible explanation for the between-country differences in the means is different student experiences in new and novel situations. The U.S. student experiences in experimental physics and chemistry was observed to be greater than those for Japanese or Australian students. In other areas as well, the U.S. students were encouraged to experiment to find solutions in new and novel situations and to new and novel problems more than was observed in the other two countries. Some Japanese research supports this thesis in comparisons between United State and Japanese students (Azuma, Kashiwagi, & Hess, 1981; Azuma, 1984).

The within country sex comparisons for AMT indicate a sex difference for Australian students favoring females (at $p<.01$), and no significant sex difference for Japanese or for United States students (Table 3). The data and observations do not clarify why these differences, or lack of differences, occur. Prior research suggests females perform better in mathematics computation and less well ir higher orders of mathematics. The AMT is not a test of computation skills, but of higher cognitive order, abstract mathematics.

[.....PLACE TABLE 3 ABOUT HERE.....]

For schools that group by ability, membership in an accelerated mathematics group has the highest significant predictive regression weight for spatial relations in Australia (raw weight, 9.56 at $p<.0001$) and the second highest predictive regression weight for the U.S. sample (raw weight, 5.37 at $p<.0001$) (Table 4). Membership in the lowest mathematics ability group has a

significant negative regression weight for U.S. students (raw weight, -4.41 at $p<.0001$), however similar membership has no significant regression weight for the Australia sample. The finding of a non-significant regression weight for the Australia sample for membership in the lowest mathematics ability group suggests membership in this group does not have the same developmental effects for spatial relations for the Australian sample as compared with the U.S. sample.

[.....PLACE TABLE 4 ABOUT HERE.....]

Cross-cultural comparison of the seventh and eighth grade spatial relations means indicates the Japan sample means are highest, followed by the United States and Australia (Table 5). The between country differences are significant at $p<.01$. The within-country differences in the seventh and eighth grade means are significant for the U.S. and Australia (at $p<.0001$), but no significant difference exists for Japan (Table 2). The percent difference between the seventh and eighth grade means is: Australia, 8%; Japan, 2%; and United States, 24%.

[.....PLACE TABLE 5 ABOUT HERE.....]

There are no significant sex differences in the means for any country (Table 6).

[.....PLACE TABLE 6 ABOUT HERE.....]

A possible explanation for the differences in the development of spatial relations may be in experiences that develop spatial relations. The Japanese students have many paper folding experiences that develop this construct, beginning in pre school. The U.S. seventh grade students have few of these experiences, except those in the accelerated mathematics ability group. It is not until eighth grade that U.S. students have experiences constructing three

dimensional objects from a pattern and the reverse process, and this is principally in the two accelerated U.S. eighth grade mathematics ability groups. The U.S. eighth grade lowest mathematics ability group has few of these experiences and its mean is not significantly different from the U.S. seventh grade spatial relations mean. The students in the Australia sample were observed to have fewer of these experiences than was found for Japan, the U.S. seventh grade accelerated group or the two U.S. eighth grade accelerated groups.

A second observation supporting the hypothesis that spatial relations experiences are important to student development of spatial relations lies in the Australian sample. One of the schools differentiates between sexes in the vocational arts curriculum. Males are assigned drafting, woodworking, and shop courses and females are assigned cooking and sewing, principally the former. In this school the eighth grade female spatial relations mean is higher than that of the male and in tenth grade the reverse is true. A second Australian school has no gender or ability group course differentiation. This school has a strong emphasis on mathematics related computer education, including computer graphing. In this school the eighth grade female spatial relations mean is significantly higher than that of the male (at $p<.03$).

Among the other variables considered, the most consistently significant regression weight in all regressions is intrinsic motivation to study mathematics (see Tables 1, 4, 7, and 9). This variable is important for both sexes and all ethnic groups. It is the one variable, aside from student grade level and mathematics ability group assignment, that is what may be termed a "universal predictor".

In the sex by ethnicity regressions, mathematics confidence and lack of

anxiety are consistently significant predictors for Australian and U.S. caucasian males and Japanese males, but not for females in any regression (Tables 7 through 10). Some research suggests these two variables may be dominant male group variables.

[.....PLACE TABLE 7 ABOUT HERE.....]

[.....PLACE TABLE 8 ABOUT HERE.....]

[.....PLACE TABLE 9 ABOUT HERE.....]

[.....PLACE TABLE 10 ABOUT HERE.....]

Means, standard deviations and correlations by-country-gender-ethnicity are contained in the Appendix.

The preliminary findings of this investigation suggest schools play an important role in student development of abstract mathematical thought and spatial relations. The cross-cultural nature of the study helps to clarify findings in a single country. More research is needed to further define ways to enhance student mathematics achievement.

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Table 1

Significant Raw Regression Weights for Abstract Mathematical Thought using Forward Addition, Backward Elimination and Stepwise Regressions: Australia 1986, Japan 1984, and USA 1984 Samples

Variables	Australia n=979	Japan n=216	USA n=549
Grade 8	5.88****		10.05****
Grade 9	10.61****		
Highest mathematics ability group	15.73****		14.81****
Middle mathematics ability group			
Lowest mathematics ability group	.		-8.18****
Last mathematics grade	.		-1.16**
Confidence	0.53**	1.08***	
Mother	.		
Father	.		
Extrinsic motivation	.		
Teacher[a]			-0.48**
Math as male domain	.	0.98**	0.65****
Usefulness			
Anxiety	0.44*		0.32**
Intrinsic motivation	.	0.89**	
Completes mathematics assignments			
Learns quickly	.		
Comprehends easily			3.19***
Retains well			
Independent			
Teacher reported mathematics interest	1.94**		
Ethnicity Caucasian	6.44*		
Ethnicity Black			
Ethnicity Oriental			
Gender[b]	2.14*		-2.42**
R^2=	.49	.26	.66
R=	.7	.51	.81
Degrees of freedom	7 and 712	3 and 113	10 and 415
F=	73.41	12.91	79.53
p<	.0001	.0001	.0001

[a] The teacher scale is believed to be a dependency scale.
[b] Gender is coded male 1, female 2.
*p<.05; **p.01; ***p<.001; ****p<.0001

Table 2

Abstract Mathematical Thought and Spatial Relations Comparisons by Grade: Australia 1986 Sample, Japan 1984 Sample, United States 1984 Sample

Variable	Grade 8			Grade 7			Percent change
	n	Mean	S.D.	n	Mean	S.D.	
Australia							
Spatial relations+++++	517	26.18**	11.77	273	24.28**	11.09	8
Abstract mathematical thought++++++	501	39.19****	14.42	271	32.71****	12.36	20
Japan							
Spatial relations+++	38	36.76	14.99	165	35.95	11.33	2
Abstract mathematical thought++++	40	47.52**	15.21	166	41.20**	12.51	15
United States							
Spatial relations+	248	33.18**	12.35	264	26.69**	10.48	24
Abstract mathematical thought++	215	49.90**	13.68	255	44.75**	14.19	12

Note. Asterisks designate statistically significant differences between grades seven and eight within each country.
Means are given as raw scores.
The maximum spatial relations score is 60.
The maximum abstract mathematical thought score is 80.

** $p < .01$. ****$p < .0001$

\+ DF = 247 and 263, F =0.01
++ DF = 214 and 254, F =0.71
+++ DF = 37 and 164, F =0.02
++++DF = 39 and 165, F =0.10
++++DF = 516 and 273, F =
++++++DF = 500 and 270, F =

Table 3

Abstract Mathematical Thought Means, by Sex: Australia 1986 Sample, Japan 1984 Sample, and United States 1984 Sample

	Australia		Japan		United States	
n	male (477)	female (456)	male (103)	female (103)	male (227)	female (243)
Raw mean score	36.84**	39.23**	42.80	42.06	47.06	47.15
S.D.	15.84	13.74	14.14	12.42	15.57	12.78

Note. Asterisks designate within country significant differences between the male and female means. Total possible score is 80

**p<.01.

Table 4

Significant Raw Regression Weights for Spatial Relations using Forward Addition, Backward Elimination and Stepwise Regressions: Australia 1986, Japan 1984, and USA 1984 Samples

Variables	Australia n=979	Japan n=216	USA n=549
Grade 8	3.01*		9.10****
Grade 9			
Highest mathematics ability group	9.56****		5.37****
Middle mathematics ability group			
Lowest mathematics ability group	.		-4.41****
Last mathematics grade	.		
Confidence	.	.	
Mother	.		
Father	.		
Extrinsic motivation	.		
Teacher[a]	.52*		-0.47**
Math as male domain	.	.	
Usefulness	.	1.11***	
Anxiety	.55*		
Intrinsic motivation	.	.	0.61****
Completes mathematics assignments			-2.96**
Learns quickly			
Comprehends easily	.		
Retains well			
Independent			
Teacher reported mathematics interest			1.78***
Ethnicity Caucasian			
Ethnicity Black			-5.61****
Ethnicity Oriental			
Gender[b]			
R^2=	.27	.07	.36
R=	.5	.26	.6
Degrees of freedom	3 and 712	1 and 113	8 and 472
F=	30.37	9.25	25.78
p<	.0001	.001	.0001

[a] The teacher scale is believed to be a dependency scale.
[b] Gender is coded male 1, female 2.
*p<.05; **p.01; ***p<.001; ****p<.0001

Table 5

Abstract Mathematical Thought and Spatial Relations Means, by Country: Australia 1986, Japan 1984, and USA 1984 Samples

	Australia (n=937)		Japan (n=206)		United States (n=470)	
	mean	S.D.	mean	S.D.	mean	S.D.
Abstract mathematical thought	37.94	14.97	43.43	13.28	47.11	14.18
	(n=958)		(n=203)		(n=513)	
Spatial relations	25.92	11.65	36.10	12.06	29.84	11.87

Note. Difference between the means of the three countries is significant at $p<.01$ for both variables. Total possible abstract mathematical thought score is 80. Total possible spatial relations score is 60.

Table 6

Spatial Relations Means, by Sex: Australia 1986 Sample, Japan 1984 Sample, and United States 1984 Sample

	Australia		Japan		United States	
n=	male (465)	female (448)	male (104)	female (99)	male (247)	female (265)
Raw mean score	26.16	25.87	37.20	34.94	29.78	29.93
S.D.	12.38	10.67	12.54	11.48	12.34	11.43

Note. There are no within country significant differences between the male and female means. Total possible spatial relations score is 60.

Table 7

Significant Raw Regression Weights for Spatial Relations using Backward and Stepwise Regressions: By Country by Ethnicity by Sex

Variable	Raw regression weight									
	Australia (n=979)				Japan (n=216)		United States (n=549)			
	Caucasian		Asian				Caucasian		Black	
	male n=323	female n=338	male n=33	female n=24	male n=54	female n=60	male n=194	female n=194	male n=30	female n=35
Grade in school[a]							8.76****	11.31****	6.91**	9.50**
Accelerated mathematics ability group	9.99****	4.41****					5.01****	5.53****		6.52**
Confidence							1.03*			
Father					-2.10**					-0.86**
Teacher	0.39*	0.36*			4.10**					
Mathematics as male domain				0.98*						
Usefulness			0.83*			1.45**				
Anxiety	0.45**									
Intrinsic motivation		0.39*						0.59***		
Completes assignments							-5.98**			
Comprehends easily		2.45****	5.96***	6.02***						
Learns quickly								4.34***		
Mathematics interest		2.28****					2.09**			
R^2=	.30	.25	.39	.45	.14	.11	.24	.40	.15	.42
Adjusted R^2	.30	.24	.39	.45	.11	.13	.24	.38	.12	.40
R=	.57	.50	.62	.67	.37	.33	.49	.63	.39	.65
Degrees of freedom	3 and 322	3 and 337	1 and 32	1 and 23	2 and 53	1 and 59	5 and 193	4 and 193	1 and 29	3 and 34
F=	34.35	22.51	9.74	8.70	4.35	7.33	13.12	31.53	5.13	7.36
p<	.0001	.0001	.001	.001	.01	.01	.0001	.0001	.03	.001

[a] Grade in school is coded seventh 1, eighth 2.

*p<.05; *p.01; ***p<.001; ****p<.0001

Table 8

Significant Standardized Regression Weights for Spatial Relations using Backward and Stepwise Regressions: By Country by Ethnicity by Sex

Variable	Raw regression weight									
	Australia (n=979)				Japan (n=206)		United States (n=549)			
	Caucasian		Asian				Caucasian		Black	
	male n=323	female n=338	male n=33	female n=24	male n=54	female n=60	male n=194	female n=193	male n=30	female n=35
Grade in school[a]							.34****	.45****	.17**	.42**
Accelerated mathematics ability group	.34****	.20****					.30****	.36****		.51**
Confidence							.21*			
Father					-.38**					-.23**
Teacher	.10*	.12*			.49**					
Mathematics as male domain				.01*						
Usefulness			.45*			.39**				
Anxiety	.13**									
Intrinsic motivation		.12*						.19***		
Completes assignments							-.19**			
Comprehends easily		.18****	.62***	.97***						
Learns quickly								.19***		
Mathematics interest		.14****					.19**			
R^2=	.30	.25	.39	.45	.14	.11	.24	.40	.15	.42
Adjusted R^2	.30	.24	.39	.45	.11	.13	.24	.38	.12	.40
R=	.57	.50	.62	.67	.37	.33	.49	.63	.39	.65
Degrees of freedom	3 and 322	3 and 337	1 and 32	1 and 23	2 and 53	1 and 59	5 and 193	4 and 193	1 and 29	3 and 34
F=	34.35	22.51	9.74	8.70	4.35	7.33	13.12	31.53	5.13	7.36
p<	.0001	.0001	.001	.001	.01	.01	.0001	.0001	.03	.001

[a] Grade in school is coded seventh 1, eighth 2.

*p<.05; *p.01; ***p<.001; ****p<.0001

Table 9

Significant Raw Regression Weights for Abstract Mathematical Thought using Backward and Stepwise Regressions: By Country by Ethnicity by Sex

Variable	Raw regression weight									
	Australia (n=979)				Japan (n=216)		United States (n=549)			
	Caucasian		Asian				Caucasian		Black	
	male n=323	female n=338	male n=33	female n=24	male n=54	female n=60	male n=179	female n=175	male n=21	female n=35
Grade in school[a]	13.08****	10.23***		30.29***			11.18****	8.85****		15.37**
Accelerated mathematics ability group	12.92****	13.55****	15.37***	7.77*			13.15****	12.02****		11.22**
Confidence	0.47*				1.24*					
Father					-2.62**					
Teacher					3.71**		-0.80**			
Mathematics as male domain	-0.38**	0.38**				1.63**	0.82**	0.53**		
Anxiety	0.59**				1.64*		0.67**			
Intrinsic motivation						1.20**				1.61**
Completes assignments										4.56*
Comprehends easily			8.59**				5.92***			
Learns quickly		3.02****							15.14**	
Retains well	2.46**							4.87****		
Independent			-6.00*							
Mathematics interest	2.93**			9.64***						
R^2=	.49	.51	.54	.52	.49	.27	.65	.64	.38	.74
Adjusted R^2	.49	.51	.54	.52	.45	.25	.62	.64	.41	.64
R=	.7	.72	.73	.72	.7	.52	.81	.60	.61	.86
Degrees of freedom	6 and 322	3 and 337	2 and 32	2 and 23	4 and 53	2 and 59	6 and 178	4 and 174	1 and 20	4 and 34
F=	37.38	69.25	11.39	7.17	11.89	10.73	53.40	75.81	11.50	12.87
p<	.0001	.0001	.0001	.001	.0001	.0001	.0001	.0001	.01	.0001

[a] Grade in school is coded seventh 1, eighth 2.

*p<.05; *p.01; ***p<.001; ****p<.0001

Table 10

Significant Standardized Regression Weights for Abstract Mathematical Thought using Backward and Stepwise Regressions: By Country by Ethnicity by Sex

Variable	Raw regression weight									
	Australia (n=979)				Japan (n=216)		United States (n=549)			
	Caucasian		Asian				Caucasian		Black	
	male n=323	female n=338	male n=33	female n=24	male n=54	female n=60	male n=179	female n=175	male n=21	female n=35
Grade in school[a]	.33****	.33***		.90***			.39****	.37****		.65**
Accelerated mathematics ability group	.39****	.47****	.65***	.15*			.71****	.73****		.59**
Confidence	.11*				.37*					
Father					-.42**					
Teacher					.40**		-.06**			
Mathematics as male domain	-.11**	.11**				.31**	.14**	.11**		
Anxiety	.16**				.35*		.01**			
Intrinsic motivation						.30**				.39**
Completes assignments										.20*
Comprehends easily			.11**				.15***			
Learns quickly		.27****							.66**	
Retains well	.20**							.19****		
Independent			-.23*							
Mathematics interest	.21**			1.05***						
R^2=	.49	.51	.54	.52	.49	.27	.65	.64	.38	.74
Adjusted R^2	.49	.51	.54	.52	.45	.25	.62	.64	.41	.64
R=	.7	.72	.73	.72	.7	.52	.81	.60	.61	.86
Degrees of freedom	6 and 322	3 and 337	2 and 32	2 and 23	4 and 53	2 and 59	6 and 178	4 and 174	1 and 20	4 and 34
F=	37.38	69.25	11.39	7.17	11.89	10.73	53.40	75.81	11.50	12.87
p<	.0001	.0001	.0001	.001	.0001	.0001	.0001	.0001	.01	.0001

[a] Grade in school is coded seventh 1, eighth 2.

*p<.05; *p.01; ***p<.001; ****p<.0001

Appendix

Australia, Japan, United States 1984-1986 Samples: Correlations, Means, and Standard Deviations

Variables

Dependent Variables

1. Abstract mathematical thought (Iowa Algebra Aptitude Test Score)
2. Spatial relations (Differential Aptitude-Space Relations Section Score)

Independent Variables

3. Mathematics confidence
4. Mother (as supporter and encourager of mathematical pursuits)
5. Father (as supporter and encourager of mathematical pursuits)
6. Extrinsic mathematics motivation (prizes, awards, praise for mathematics achievement; Fennema-Sherman call this attitude "mathematics success")
7. Teacher (as supporter and encourager of mathematical pursuits)
8. Mathematics as a male domain (mathematics as gender neutral)
9. Mathematics usefulness
10. Mathematics anxiety (mathematics comfort)
11. Mathematics intrinsic motivation (mathematics effectance motivation)
12. Mathematics interest.

Measurements used for Variables

1. Abstract mathematical thought is measured by the Iowa Algebra Aptitude Test (1967). Score range is 0-80.
2. Spatial Relations is measured by the Psychological Corporation Space Relations Section of the Differential Aptitude Test (1982). Score range is 0-60.

3 - 11. Mathematics attitudes are measured by the Fennema-Sherman Mathematics

Attitudes Scales (1976). Score range is -10 to +10, low to high.

12. Mathematics Interest is measured by the Iben Teacher Questionnaire (1984).

Score range is 1 to 5, low to high.

Table A-1

Correlations: Total Australia 1986 Sample (n = 937)

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	37.94	25.92	-0.46	0.64	1.18	0.13	-0.91	2.84	1.43	-0.48	-0.51	3.47
S.D.	14.97	11.65	3.36	3.73	3.92	3.84	2.94	4.48	4.05	3.26	3.19	1.10
n	937	958	889	890	885	888	888	887	883	883	883	880
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	55											
CONFIDENCE	29	22										
MOTHER	23	18	51									
FATHER	20	14	44	61								
EXTRINSIC MOTIVATION	19	14	37	36	48							
TEACHER	24	20	39	31	33	36						
MATHEMATICS AS A MALE DOMAIN	25	16	25	37	37	30	22					
USEFULNESS	22	18	45	52	57	45	39	39				
ANXIETY (COMFORT)	19	19	65	43	35	31	30	23	45			
INTRINSIC MOTIVATION	12	12	52	44	37	27	25	18	43	56		
MATHEMATICS INTEREST	39	31	25	22	17	14	25	26	25	20	17	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
All correlations are at $p<.0001$.

Table A-2

Correlations: All Males, Australia 1986 Sample (n = 477)

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	36.84	26.16	0.04	0.72	1.08	0.38	-0.97	1.71	1.66	0.00	-0.09	3.44
S.D.	15.84	12.38	3.65	3.83	4.00	4.00	3.07	4.39	4.15	3.44	3.37	1.12
n	477	465	423	425	421	422	422	421	417	417	417	424
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	56											
CONFIDENCE	32	24										
MOTHER	22	21	54									
FATHER	18	15**	48	57								
EXTRINSIC MOTIVATION	16***	16***	37	34	47							
TEACHER	22	22	37	29	36	38						
MATHEMATICS AS A MALE DOMAIN	15**	15**	32	38	30	27	17***					
USEFULNESS	23	23	46	52	56	40	38	45				
ANXIETY (COMFORT)	24	20	64	48	33	28	27	33	51			
INTRINSIC MOTIVATION	11**	08NS	49	48	38	21	25	30	41	53		
MATHEMATICS INTEREST	43	32	30	21	16***	12**	25	25	26	18	19	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
Except as noted, all correlations are at $p<.0001$.
NS indicates $p>.05$.

*$p<.05$, **$p<.01$, ***$p<.001$.

Table A-3

Correlations: All Females Australia 1986 Sample (n = 456)

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	39.23	25.87	-1.01	0.56	1.25	-0.08	-0.88	3.90	1.22	-0.97	-0.95	3.54
S.D.	13.74	10.67	2.95	3.62	3.79	3.73	2.84	4.27	3.94	2.96	2.92	1.04
n	456	448	426	425	424	426	426	426	426	426	426	415
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	55											
CONFIDENCE	28	24										
MOTHER	25	14**	48									
FATHER	22	14**	41	65								
EXTRINSIC MOTIVATION	24	15***	38	39	49							
TEACHER	24	23	42	33	28	35						
MATHEMATICS AS A MALE DOMAIN	34	24	25	39	45	37	29					
USEFULNESS	22	14**	46	52	57	49	42	38				
ANXIETY (COMFORT)	17***	22	66	38	37	34	36	20	37			
INTRINSIC MOTIVATION	15***	17***	52	39	36	33	26	13**	47	56		
MATHEMATICS INTEREST	33	32	22	20	12**	14**	24	23	20	23	17***	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
Except as noted, all correlations are at $p<.0001$.

*$p<.05$, **$p<.01$, ***$p<.001$.

Table A-4

Correlations: Caucasian Males Australia 1986 Sample (n = 429)

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	37.46	26.20	0.02	0.74	1.09	0.40	-0.94	1.77	1.70	0.08	-0.07	3.43
S.D.	15.73	12.59	3.67	3.91	4.03	4.04	3.10	4.40	4.22	3.52	3.38	1.13
n	429	418	380	382	378	379	379	378	374	374	374	384
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	57											
CONFIDENCE	33	25										
MOTHER	23	22	56									
FATHER	19	14**	46	57								
EXTRINSIC MOTIVATION	17***	17***	37	34	48							
TEACHER	22	23	36	30	34	39						
MATHEMATICS AS A MALE DOMAIN	13**	15**	34	41	32	28	18***					
USEFULNESS	22	23	45	52	55	40	38	46				
ANXIETY (COMFORT)	23	20	63	48	33	29	27	33	50			
INTRINSIC MOTIVATION	11*	08NS	52	49	39	24	26	33	40	55		
MATHEMATICS INTEREST	44	33	31	22	18***	14**	27	26	29	18***	22	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
Except as noted, all correlations are at $p<.0001$.
NS indicates $p>.05$.

*$p<.05$, **$p<.01$. ***$p<.001$.

Table A-5

Correlations: Caucasian Females Australia 1986 Sample (n = 413)

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	39.58	26.10	-1.04	0.52	1.21	-0.06	-0.91	3.98	1.18	-0.97	-1.02	3.51
S.D.	13.78	10.73	3.01	3.58	3.82	3.79	2.91	4.30	4.00	3.02	2.94	1.05
n	413	405	383	383	382	383	383	383	383	383	383	376
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	54											
CONFIDENCE	29	25										
MOTHER	28	16***	49									
FATHER	25	16***	41	64								
EXTRINSIC MOTIVATION	24	14**	37	38	48							
TEACHER	26	23	42	32	28	36						
MATHEMATICS AS A MALE DOMAIN	33	22	25	41	45	37	28					
USEFULNESS	24	14**	47	49	56	49	42	38				
ANXIETY (COMFORT)	18***	23	65	40	38	34	36	21	39			
INTRINSIC MOTIVATION	17***	19	51	37	34	30	24	11*	46	57		
MATHEMATICS INTEREST	34	32	25	23	14**	16***	27	26	20	26	18***	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
Except as noted, all correlations are at $p<.0001$.
NS indicates $p>.05$.

*$p<.05$, **$p<.01$. ***$p<.001$.

Table A-6

Correlations: Asian Males Australia 1986 Sample (n = 36)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	35.14	27.17	0.70	0.51	1.23	0.16	-0.85	1.26	1.72	-0.52	-0.24	3.74
S.D.	15.46	10.77	3.34	2.86	3.63	3.41	2.57	4.20	3.73	2.60	3.62	0.86
n	36	35	34	34	34	34	34	34	34	34	34	34
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	48**											
CONFIDENCE	32*	16										
MOTHER	14	12	38**									
FATHER	11	24	59***	64****								
EXTRINSIC MOTIVATION	03	06	45**	48**	43**							
TEACHER	07	00	56***	26	62****	23						
MATHEMATICS AS A MALE DOMAIN	35*	36*	27	00	18	29	28					
USEFULNESS	27	30	60***	65****	69****	66****	49**	33*				
ANXIETY (COMFORT)	42**	27	80****	46**	48**	20	40**	24	60***			
INTRINSIC MOTIVATION	14	14	30	39**	37*	-04	24	-06	44**	40**		
MATHEMATICS INTEREST	36*	17	23	00	-11	-10	-07	17	-10	32*	-11	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.

*p<.05, **p<.01, ***p<.001, ****p<.0001.

Table A-7

Correlations: Asian Females Australia 1986 Sample (n = 25)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	40.48	25.56	-0.75	1.02	1.27	-0.27	-0.85	3.78	1.80	-1.19	-0.30	4.08
S.D.	11.35	10.06	1.65	3.79	2.85	3.20	1.97	4.24	3.45	1.72	2.54	0.81
n	25	25	25	24	24	25	25	25	25	25	25	25
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	53**											
CONFIDENCE	06	14										
MOTHER	-13	-16	27									
FATHER	-11	-15	25	88****								
EXTRINSIC MOTIVATION	22	09	51	45	57							
TEACHER	-02	10	69****	44*	41*	42*						
MATHEMATICS AS A MALE DOMAIN	31	48**	21	09	31	32	41*					
USEFULNESS	-06	11	51**	74****	77****	62***	45**	31				
ANXIETY (COMFORT)	-26	-11	68***	13	13	34	53**	04	22			
INTRINSIC MOTIVATION	-15	-07	70****	43*	58**	50**	73****	43*	61**	52**		
MATHEMATICS INTEREST	23	39*	-26	-10	-15	-27	-22	09	-10	-34	-32	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.

*p<.05, **p<.01, ***p<.001, ****p<.0001.

Table A-8

Correlations: Other Males Australia 1986 Sample[+] (n = 12)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	19.75	21.92	-1.21	0.55	0.39	0.14	-2.96	0.82	-.31	-1.51	-0.42	2.33
S.D.	11.52	8.32	3.55	3.96	4.39	4.56	3.31	4.72	2.66	2.34	2.30	1.21
n	12	12	9	9	9	9	9	9	9	9	9	6
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	55*											
CONFIDENCE	-69*	-07										
MOTHER	-27	-16	57									
FATHER	-40	05	84	36								
EXTRINSIC MOTIVATION	12	21	03	19	19							
TEACHER	26	59	22	-19	62*	25						
MATHEMATICS AS A MALE DOMAIN	-25	-85**	-12	31	-37	-07	-81**					
USEFULNESS	-26	-47	02	14	19	-20	00	39				
ANXIETY (COMFORT)	-63*	-58	53	55	39	01	-24	44	55			
INTRINSIC MOTIVATION	-18	-59	-08	07	02	-08	-10	59	88**	42		
MATHEMATICS INTEREST	-04	02	-48	00	-47	90	13	-19	-88	-76	-74	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.

[+] Other males include African-Black and Aboriginals.

*p<.05, **p<.01.

Table A-9

Correlations: Other Females Australia 1986 Sample+ (n = 18)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	29.61	21.28	-0.62	0.68	1.99	-0.23	-0.40	2.51	1.32	-0.73	-0.35	3.50
S.D.	12.88	9.34	3.13	4.41	4.38	3.30	2.28	3.58	3.45	3.13	3.03	0.85
n	18	18	18	18	18	18	18	18	18	18	18	14
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	51**											
CONFIDENCE	37	33										
MOTHER	17	19	33									
FATHER	16	13	47*	79****								
EXTRINSIC MOTIVATION	39	55**	57**	61**	60**							
TEACHER	19	30	33	46*	40	30						
MATHEMATICS AS A MALE DOMAIN	34	33	40	51**	59**	51**	60**					
USEFULNESS	12	31	20	82****	73***	62**	30	54**				
ANXIETY (COMFORT)	29	32	76***	23	24	48*	02	22	25			
INTRINSIC MOTIVATION	19	40	63**	72***	52**	75***	51**	50*	61**	57**		
MATHEMATICS INTEREST	24	36	-03	14	-01	36	-05	-30	39	14	26	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.

+ Other females include African-Black and Aboriginals.

*p<.05, **p<.01, ***p<.001, ****p<.0001.

Table A-10

Correlations: Japan 1984 Sample (n = 206)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11
MEAN	42.43	36.10	-1.03	0.55	0.84	2.46	-0.61	1.06	2.23	-0.03	0.50
S.D.	13.28	12.06	3.37	1.92	1.76	2.51	1.56	2.17	2.71	2.50	3.06
n	206	203	121	121	121	121	121	121	122	121	121
ABSTRACT MATHEMATICAL THOUGHT											
SPATIAL RELATIONS	51****										
CONFIDENCE	43****	20*									
MOTHER	26**	06	24**								
FATHER	10	01	16*	64****							
EXTRINSIC MOTIVATION	22**	06	15	41****	51****						
TEACHER	16	10	47****	29***	29***	21**					
MATHEMATICS AS A MALE DOMAIN	15	15	-12	-03	-05	06	-19*				
USEFULNESS	31***	30***	25***	44****	35****	43****	25**	20*			
ANXIETY (COMFORT)	38****	12	74****	17*	13	21**	34****	05	37****		
INTRINSIC MOTIVATION	43****	21**	56****	38****	21**	37****	24**	03	43****	60****	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.

*p<.05, **p<.01, ***p<.001, ****p<.0001.

Table A-11

Correlations: Males Japan 1984 Sample (n = 103)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11
MEAN	42.80	37.20	0.05	0.65	0.85	2.38	0.01	0.37	2.67	0.66	1.21
S.D.	14.14	12.54	3.26	2.09	1.99	2.65	1.35	1.82	2.74	2.45	2.98
n	103	104	60	60	60	60	60	60	60	60	60
ABSTRACT MATHEMATICAL THOUGHT											
SPATIAL RELATIONS	54****										
CONFIDENCE	56****	18									
MOTHER	20	09	34**								
FATHER	03	-06	30**	71****							
EXTRINSIC MOTIVATION	20	-04	18	64****	63****						
TEACHER	26*	24*	24*	48****	58****	41***					
MATHEMATICS AS A MALE DOMAIN	-16	04	-39**	-18	-20	-14	-09				
USEFULNESS	22	19	23	42***	46****	53****	40***	06			
ANXIETY (COMFORT)	57****	08	68****	24*	22	32**	12	-06	47****		
INTRINSIC MOTIVATION	40***	18	56****	50****	31**	47****	12	-30**	46****	60****	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.

*p<.05, **p<.01, ***p<.001, ****p<.0001.

Table A-12

Correlations: Females Japan 1984 Sample (n = 103)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11
MEAN	42.06	34.94	-2.09	0.45	0.84	2.54	-1.23	1.74	1.80	-0.70	-0.21
S.D.	12.42	11.48	3.15	1.74	1.53	2.37	1.51	2.29	2.64	2.38	2.99
n	103	99	61	61	61	61	61	61	62	61	61
ABSTRACT MATHEMATICAL THOUGHT											
SPATIAL RELATIONS	48****										
CONFIDENCE	31**	17									
MOTHER	32**	01	12								
FATHER	16	07	01	53****							
EXTRINSIC MOTIVATION	24*	16	15	11	34**						
TEACHER	06	-09	54****	10	01	.07					
MATHEMATICS AS A MALE DOMAIN	45****	32**	28*	15	10	21	-06				
USEFULNESS	37**	38***	22	47****	20	34**	02	44****			
ANXIETY (COMFORT)	18	10	76****	06	01	11	39***	33**	22		
INTRINSIC MOTIVATION	44****	19	49****	23*	08	31**	20	43***	35**	54****	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.

*p<.05, **p<.01, ***p<.001, ****p<.0001.

Table A-13

Correlations: Total United States 1984 Sample (n = 549)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	47.11	29.84	3.60	4.83	4.54	4.69	3.00	5.50	5.09	2.31	1.95	3.64
S.D.	14.18	11.87	3.51	2.99	3.56	3.19	2.67	3.16	3.18	3.68	3.43	1.39
n	470	513	549	549	549	549	549	549	549	549	549	549
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	57											
CONFIDENCE	26	22										
MOTHER	24	21	50									
FATHER	28	20	34	63								
EXTRINSIC MOTIVATION	10*	11**	42	50	41							
TEACHER	20	16	58	57	46	51						
MATHEMATICS AS A MALE DOMAIN	30	23	28	41	38	44	34					
USEFULNESS	28	27	50	62	54	47	49	48				
ANXIETY (COMFORT)	20	20	82	36	21	31	48	19	39			
INTRINSIC MOTIVATION	16	18	68	42	28	44	56	22	49	65		
MATHEMATICS INTEREST	50	39	37	25	25	21	32	29	29	32	26	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
All correlations are at $p<.0001$ except as noted.

*$p<.05$, **$p<.01$, ***$p<.001$.

Table A-14

Correlations: Males United States 1984 Sample (n = 264)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	47.06	29.78	4.25	5.00	4.53	4.60	3.21	4.52	5.11	2.96	2.10	3.70
S.D.	15.57	12.34	3.42	3.12	3.67	3.36	2.89	3.10	3.21	3.37	3.59	1.39
n	227	247	264	264	264	264	264	264	264	264	264	264
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	53											
CONFIDENCE	34	26										
MOTHER	31	25	55									
FATHER	31	25	44	75								
EXTRINSIC MOTIVATION	12*	11NS	50	54	48							
TEACHER	22	17**	65	59	50	57						
MATHEMATICS AS A MALE DOMAIN	30	22	37	46	45	43	38					
USEFULNESS	33	32	60	68	60	50	55	52				
ANXIETY (COMFORT)	29	24	81	40	33	39	59	28	46			
INTRINSIC MOTIVATION	20	20	70	46	39	49	65	25	54	68		
MATHEMATICS INTEREST	53	35	42	27	26	25	37	29	29	36	30	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
All correlations are at $p<.0001$ except as noted.
NS indicates $p>.05$.

*$p<.05$, **$p<.01$, ***$p<.001$.

Table A-15

Correlations: Females United States 1984 Sample (n = 281)

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	47.15	29.93	3.01	4.69	4.55	4.75	2.84	6.38	5.04	1.73	1.83	3.62
S.D.	12.78	11.43	3.49	2.87	3.45	3.03	2.44	2.96	3.17	3.85	3.29	1.36
n	243	265	281	281	281	281	281	281	281	281	281	281
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	61											
CONFIDENCE	18**	19***										
MOTHER	15**	16**	46									
FATHER	24	14**	25	51								
EXTRINSIC MOTIVATION	07NS	12*	36	46	33							
TEACHER	17**	14**	52	55	41	45						
MATHEMATICS AS A MALE DOMAIN	34	26	34	44	34	47	38					
USEFULNESS	23	23	42	55	48	43	43	50				
ANXIETY (COMFORT)	13*	17**	82	33	11*	26	38	24	35			
INTRINSIC MOTIVATION	10NS	16**	66	38	16**	39	44	25	43	64		
MATHEMATICS INTEREST	47	42	35	22	25	18***	25	35	31	30	22	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
Rounding may cause like numbers to have different levels of significance.
All correlations are at $p<.0001$ except as noted.
NS indicates $p>.05$.

*$p<.05$, **$p<.01$, ***$p<.001$.

Table A-16

Correlations: Caucasian Males United States 1984 Sample (n = 218)

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	48.20	31.33	4.40	5.17	4.89	4.66	3.28	4.84	5.42	3.02	2.17	3.87
S.D.	15.43	12.33	3.40	3.07	3.68	3.37	2.97	2.97	3.18	3.46	3.77	1.29
n	198	206	218	218	218	218	218	218	218	218	218	218
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	51											
CONFIDENCE	33	26										
MOTHER	33	28	55									
FATHER	29	23***	42	76								
EXTRINSIC MOTIVATION	13NS	10NS	53	54	50							
TEACHER	24***	18**	65	58	48	56						
MATHEMATICS AS A MALE DOMAIN	26	17**	36	48	43	41	38					
USEFULNESS	30	27	59	71	60	54	57	51				
ANXIETY (COMFORT)	29	26	81	39	31	41	59	26	46			
INTRINSIC MOTIVATION	16**	18**	73	48	39	52	67	26	56	70		
MATHEMATICS INTEREST	54	30	38	27	24	23	36	24	25	34	28	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
All correlations are at $p<.0001$ except as noted.
NS indicates $p>.05$.

*$p<.05$, **$p<.01$, ***$p<.001$.

Table A-17

Correlations: Caucasian Females United States 1984 Sample (n = 211)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	49.02	31.24	2.86	4.55	4.63	4.58	2.80	6.74	5.05	1.53	1.63	3.73
S.D.	12.08	11.44	3.51	2.82	3.44	3.07	2.43	2.87	3.21	4.00	3.40	1.31
n	189	205	211	211	211	211	211	211	211	211	211	211
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	58											
CONFIDENCE	20**	26										
MOTHER	12NS	19**	40									
FATHER	23***	14*	25	53								
EXTRINSIC MOTIVATION	08NS	16**	34	46	34							
TEACHER	16**	15*	48	53	42	45						
MATHEMATICS AS A MALE DOMAIN	24***	26	36	47	31	47	34					
USEFULNESS	19**	22***	42	55	51	43	43	49				
ANXIETY (COMFORT)	13NS	21**	83	26	12NS	25	33	28	36			
INTRINSIC MOTIVATION	15*	23***	70	34	16**	41	41	30	45	67		
MATHEMATICS INTEREST	44	44	34	20**	22***	13*	20***	31	30	29	25	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
Differences in n may cause like or larger correlation values to have lower levels of significance.
All correlations are at $p<.0001$ except as noted.
NS indicates $p>.05$.

*$p<.05$, **$p<.01$, ***$p<.001$.

Table A-18

Correlations: Black Males United States 1984 Sample (n = 39)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	38.92	20.80	3.57	4.56	2.90	4.40	3.01	2.96	3.65	2.88	1.80	2.82
S.D.	12.44	9.05	3.31	3.27	3.11	3.44	2.50	3.39	2.95	2.73	2.64	1.60
n	25	35	39	39	39	39	39	39	39	39	39	39
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	46*											
CONFIDENCE	23	04	—									
MOTHER	04	02	53***									
FATHER	28	02	49***	66****								
EXTRINSIC MOTIVATION	26	14	40**	52***	40**							
TEACHER	03	08	66****	58****	64****	65****						
MATHEMATICS AS A MALE DOMAIN	40*	03	36**	37**	49***	53***	46***					
USEFULNESS	29	13	59****	60****	57****	34*	47***	40**				
ANXIETY (COMFORT)	19	02	86****	38**	46***	32*	57****	40**	42**			
INTRINSIC MOTIVATION	47**	20	58****	38**	40**	31*	48***	11	41**	46***		
MATHEMATICS INTEREST	35	13	53***	22	15	39**	52***	26	14	48***	42**	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
Differences in n may cause like or larger correlation values to have lower levels of significance.

*p<.05, **p<.01, ***p<.001, ****p<.0001.

Table A-19

Correlations: Black Females United States 1984 Sample (n = 51)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	36.68	22.76	3.33	5.01	4.06	5.21	3.09	5.04	4.73	2.29	2.58	3.06
S.D.	11.04	8.14	3.54	3.07	3.39	2.84	2.58	3.17	3.26	3.53	2.83	1.53
n	41	42	51	51	51	51	51	51	51	51	51	51
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	60****											
CONFIDENCE	23	14										
MOTHER	33*	13	66****									
FATHER	10	-12	36**	47***								
EXTRINSIC MOTIVATION	25	20	45***	47***	38**							
TEACHER	35**	23	66****	61****	38**	54****						
MATHEMATICS AS A MALE DOMAIN	44***	14	39**	45***	43***	58****	59****					
USEFULNESS	47***	42**	41***	61****	40***	45***	44***	55****				
ANXIETY (COMFORT)	30*	13	80****	60****	14	28*	66****	23	37**			
INTRINSIC MOTIVATION	42**	18	63****	67****	39**	41***	67****	36**	49***	62****		
MATHEMATICS INTEREST	46***	24	51****	32**	25	48***	42***	38**	32**	44***	37**	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
Differences in n may cause like or larger correlation values to have lower levels of significance.

*p<.05, **p<.01, ***p<.001, ****p<.0001.

Table A-20

Correlations: Asian Males United States 1984 Sample (n = 3)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	51.67	31.67	3.33	1.94	1.64	3.11	1.57	5.51	3.55	1.81	2.55	3.00
S.D.	20.03	16.44	7.23	1.68	1.95	2.11	2.64	0.95	4.78	6.32	3.23	1.73
n	3	3	3	3	3	3	3	3	3	3	3	3
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	99**											
CONFIDENCE	99	99										
MOTHER	98	98	99*									
FATHER	86	87	93	95								
EXTRINSIC MOTIVATION	-35	-34	-22	-16	16							
TEACHER	77	78	85	88	99	33						
MATHEMATICS AS A MALE DOMAIN	91	92	96	98	99*	06	96					
USEFULNESS	99	99	96	94	79	-48	68	85				
ANXIETY (COMFORT)	84	85	91	93	99**	21	99	99	76			
INTRINSIC MOTIVATION	99***	99**	99	98	87	-35	77	91	99	84		
MATHEMATICS INTEREST	98	98	99*	99****	95	-16	88	98	94	93	98	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
Rounding may cause like numbers to have different levels of significance.

*p<.05, **p<.01, ***p<.001, ****p<.0001.

Table A-21

Correlations: Asian Females United States 1984 Sample (n = 14)

VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12
MEAN	53.50	35.21	3.87	5.89	6.30	5.50	3.29	6.65	6.58	2.79	2.01	4.14
S.D.	11.98	11.48	3.04	2.84	3.36	3.15	1.88	1.98	1.64	2.30	2.72	0.86
n	12	14	14	14	14	14	14	14	14	14	14	14
ABSTRACT MATHEMATICAL THOUGHT												
SPATIAL RELATIONS	51											
CONFIDENCE	24	-38										
MOTHER	74**	30	58*									
FATHER	71**	25	03	42								
EXTRINSIC MOTIVATION	41	-08	16	35	26							
TEACHER	49	-13	65**	42	42	35						
MATHEMATICS AS A MALE DOMAIN	61*	01	27	46	19	73***	45					
USEFULNESS	76***	-14	28	38	44	45	51*	56*				
ANXIETY (COMFORT)	18	01	61**	44	-24	17	18	23	01			
INTRINSIC MOTIVATION	-31	-05	14	-03	-22	02	14	-31	-31	16		
MATHEMATICS INTEREST	78***	47	27	51*	59**	01	45	31	53*	21	-41	

Note: In accord with commonly accepted practices, the correlation decimal point has been omitted.
Differences in n may cause like or larger correlation values to have lower levels of significance.

*p<.05, **p<.01, ***p<.001, ****p<.0001.